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The Impact of Urinary Tract Infections in an Australian Setting: A Multi-State Model

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Length of stay and mortality associated with healthcare-associated urinary tract infections: a multistate model

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Background

The emergence of antimicrobial resistance is of particular concern with respect to urinary tract infections (UTIs).This adds further value to endeavours that aim to understand the burden of UTIs and interventions to reduce their incidence. The aims of our study are to determine

- the proportion of patients that develop a laboratory-diagnosed healthcare associated infection (HAUTI)
- the extra length of hospital stay in patients with an HAUTI
- risk of inpatient mortality associated with an HAUTI

Methods

Study Design

A non-concurrent cohort study design is used.

Setting

The setting is 8 hospitals with large health district in New South Wales, Australia.

Participants

All patients admitted for more than two days between 1 January 2010 and 30 June 2014.

Definitions

HAUTI = positive urine culture more than two days after admission, positive for at least one species of Enterobacteriaceae , > 10^5 per mL of urine and no more than two species of microorganisms.

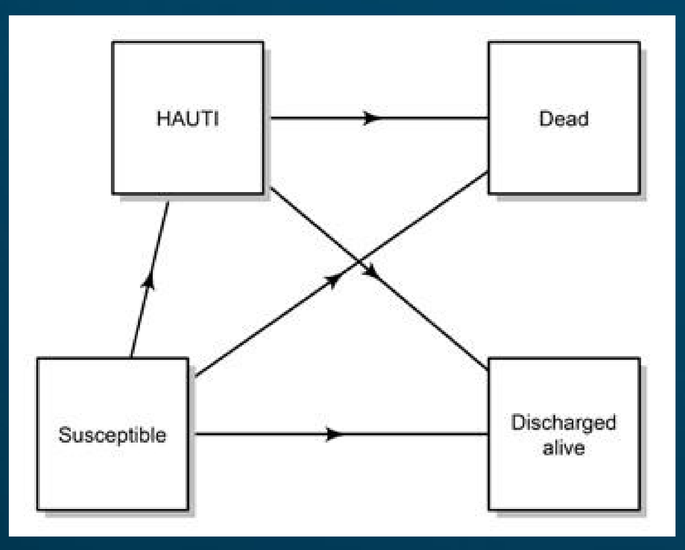
Data collection

Data were collected from two sources: the clinical coding department and the microbiology department.

Statistical analysis

Comparisons of characteristics between those who acquired an HAUTI and those who did not were compared using a chi-squared test or the Mann–Whitney U-test, Unadjusted odds ratios were calculated using Mantel-Haenszel methods. Differences in length of stay between those with an infection and those without were calculated using a multistate model,which manages time-dependent bias. To examine the risk of infection and death, we used the log link in order to get the prevalence ratios for death. We subsequently used a survival analysis using a Cox regression model.

Figure 1. Multistate model used to determine length of stay



Results

- 162,503 patient admissions included in the study
- 1.73% (95% CI 1.67–1.80) of admitted patients acquired a HAUTI.
- Using a multi-state model, the expected extra length of stay due to HAUTI was 4 days, 95% CI 3.1–5.0 days.
- Using a Cox regression model, infection significantly reduced the rate of discharge (HR 0.78, 95%CI, 0.73-0.83.
- Women were less likely to die (HR 0.71, 95%CI 0.66-0.75), whereas older patients were more likely to die (HR 1.40, 95%CI 1.38-1.43).
- Death was rarer in a tertiary referral hospital compared to other hospitals, after adjusting for age and sex (HR 0.74, 95%CI, 0.69-0.78).

Figure 2. Extra length of stay in patients with and without a HAUTI

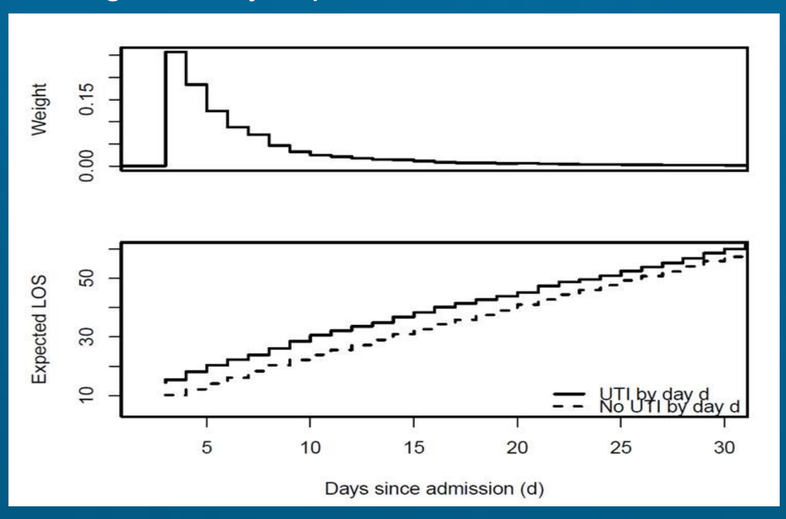


Figure 3. Cumulative incidence functions for HAUTI, discharge and death

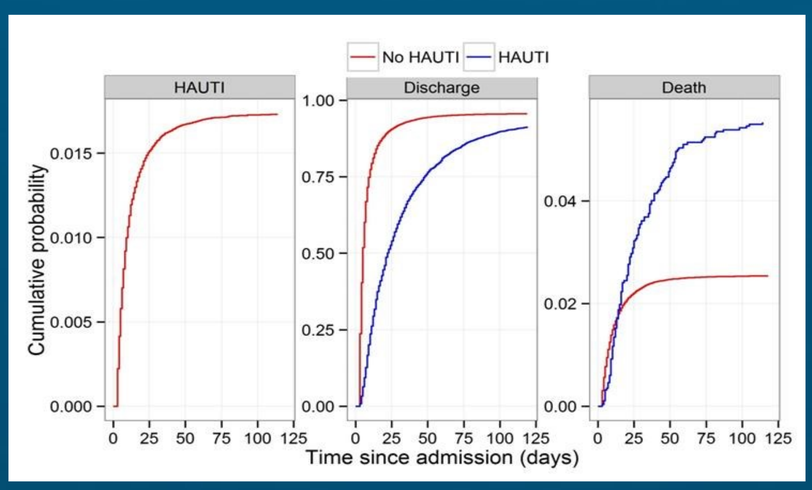


Table I. Risk of HAUTI, discharge and death using a Cox regression model

Outcome	Predictor	Hazard ratio	95% CI	P-value
HAUTI	Sex (female)	2.74	2.57-3.04	<0.001
HAUTI	Age (10 year increase)	1.31	1.28-1.33	<0.001
HAUTI	Tertiary hospital	1.26	1.16-1.37	<0.001
Discharge	Sex (female)	1.12	1.11-1.13	<0.001
Discharge	Age (10 year increase)	0.91	0.91-0.92	<0.001
Discharge	Tertiary hospital	0.80	0.79-0.80	<0.001
Discharge	HAUTI (yes vs no)	0.78	0.73-0.83	<0.001
Discharge	Tertiary hospital and HAUTI	1.23	1.14-1.32	<0.001
Dead	Sex (female)	0.71	0.67-0.75	<0.001
Dead	Age (10 year increase)	1.40	1.38-1.43	<0.001
Dead	Tertiary hospital	0.74	0.69-0.78	<0.001
Dead	HAUTI (yes vs no)	0.77	0.60-0.98	0.034
Dead	Tertiary hospital and HAUTI	1.08	0.78-1.48	0.650

Conclusions

- The first study to explore the burden of HAUTIs in hospitals using appropriate statistical methods in a developed country.
- The incidence of HAUTI and associated extra length of stay in hospital, present a burden to the hospital system.
- With increasing incidence of UTI due to antimicrobial resistant organisms, surveillance and interventions to reduce the incidence of HAUTI are required.

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